Abstract

Objectives—The generally agreed view is that there is no ideal shift system, and that most systems will have both advantages and disadvantages. As such, attention has been placed on trying to identify good and bad features of shift systems, with a view to minimising the possible ill health as a consequence of shiftwork. The present study focuses on the duration of the shift and looks at the implications for individual health, wellbeing, and alertness during the shift from the traditional eight hours to 12.

Methods—Two groups of chemical workers, one working 12 hour shifts and the other working eight hour shifts, took part. All completed a modified version of the standard shiftwork index (SSI), a set of self reported questionnaires related to health and wellbeing.

Results—The two groups did not differ on most outcome measures, although the differences that did exist suggested advantages for the 12 hour shift workers over the eight hour shift workers; with the notable exception of rated alertness at certain times of day.

Conclusions—The results are explained in terms of the design of the 12 hour shift system and the specific sequencing of shifts that seem to minimise the potential for the build up of fatigue. Although the current data moderately favour 12 hour shifts, a cautionary note is sounded with regard to the implications of the alertness ratings for performance and safety.

Keywords: shift systems; safety; health

Working shifts is associated with a range of problems that are experienced by many people—for example, physical and psychological health, disruptions to social and domestic life, and increased fatigue and sleep disturbances. Problems with shiftwork are thought to result from people being required to do the opposite of what their body would predict—that is, to stay awake during the night and to sleep during the day. One approach to reducing these problems has focused on the design of the shift system. There seems to be no ideal shift system, as most systems will have both advantages and disadvantages for those involved. However, certain variables of shift systems are thought to be more problematic for the people concerned than others—for example, the flexibility of the shift roster, the number of successive night shifts worked, the direction of shift rotation, and the timing of shifts. The present study focuses on the duration of the shift, in particular, 12 hour shifts in contrast with the more common eight hour shifts.

The working day has traditionally lasted for around eight hours. However, by working longer shifts it is possible to compress the working week into fewer days. Research on 12 hour shifts has, to date, tended to focus on the potential advantages for social and leisure time, and the potential disadvantages of increased fatigue and impaired performance and safety while at work. Little mention has been made of the possible ill health which may occur as a result of working long hours within a shorter week. Previous research has tended to produce results both for and against the use of 12 hour shifts. Although the primary reason for the recent popularity of 12 hour shifts seems to be social, even on this issue opinion seems to be divided. Because the working week is compressed into fewer days, longer periods away from work between blocks of shifts offer longer continuous periods for leisure. For example, Barton-Cunningham found that young married workers on a 12 hour “compressed” shift schedule were more satisfied with their family relations. Urgovies and Wright argue that 12 hour shifts help to accommodate the (usually domestic) needs of many nurses for a shorter working week and the desire for more free weekends. However, Wallace et al found that although her group of light manufacturing workers greatly favoured the change from working eight to 12 hour shifts, the partners of the shiftworkers did not find the new schedule advantageous for personal and family life. Thompson also reported that an experimental change from eight to 12 hour shifts resulted in complaints that the new longer shifts greatly disrupted family and social life, this time in a group of nurses.

Perhaps the main disadvantage of 12 hour shifts seems to be the build up of fatigue over the period of work and the consequences which this may have both for individual health and wellbeing, and for performance and safety. Working only two successive nights might help to reduce circadian disruption and therefore lead to better quality sleeps, thereby minimising the accumulation of fatigue. In some cases workers might only work two con-
secutive night shifts but these may be followed immediately by two successive 12 hour day shifts, thus leading to a total of 48 hours work in four days. In such circumstances, it is perhaps not surprising that high levels of fatigue are often reported. Wallace et al.21 found greatly increased levels of irritability and fatigue three years after the change from eight to 12 hour shifts. Twelve hour shifts have also been associated with increased acute fatigue, particularly on the night shift,19 reduced alertness at the beginning of the day,21 and poorer quality of nursing care.24

In view of the conflicting results which exist, a general recommendation for extended working days cannot be made. Rather, a set of guidelines have been proposed,23 by which individual job situations may be assessed in terms of their suitability for the implementation of extended working hours. The importance of the method of implementation of a new shift schedule has also been highlighted, with employee participation being a critical factor for the acceptance of a new 12 hour shift schedule.25 However, it is possible that preference for extended shift schedules may increase with experience on these shifts.24 The success of the shift system may depend on how and why it is implemented. For example, if it is just to save money, then staff are more likely to be against it than if it is introduced to reduce travelling time and reduce the number of days worked in succession between rest days.22

We conducted the present study because of the inconclusive evidence published about the advantages and disadvantages of 12 hour shifts, the possible health consequences which might result, and the paucity of studies comparing the effects of eight hour and 12 hour shifts. An opportunity arose in a much larger study of industrial shift systems to compare two groups of chemical workers, one working 12 hour shifts and the other working eight hour shifts.

### Method

**PARTICIPANTS AND SHIFT SYSTEMS**

Two groups of male chemical workers, from three different organisations, were selected from a larger sample of workers from various industries for participation in the study. The first group (n = 92) worked two 12 hour shifts (days and nights) and the second group (n = 70) worked three eight hour shifts (mornings, afternoons, and nights). Table 1 shows that there was little difference in age between the two groups. A similar proportion in each group were either married or living with someone, and there was little difference in the number of dependants in the home. Both groups had, on average, worked for similar periods in shiftwork, however, the eight hour group had spent significantly more years working on their present shift system than had the 12 hour group. The eight hour group also reported working significantly more hours a week than the 12 hour group.

Table 2 shows examples of the two types of shift systems. The nature of the shift systems were as follows: within the 12 hour group there were two different systems. The major one comprised either two or three shifts in succession either day shifts or night shifts, with either two or three rest days in between. The second, less common system, comprised four shifts in succession—that is, two days followed by two nights, before having four days off. The timing of the shifts was the same for both systems, day shifts starting at 0700 and finishing at 1900 and night shifts starting at 1900 and finishing at 0700.

There was slightly more variation in the shifts worked by the eight hour group but essentially all worked a 2–2–3 combination of mornings, afternoons, and nights in a forward (delaying) direction of rotation. The most common start and finish times of the shifts were: mornings (0600 to 1400), afternoons (1400 to 2200), and nights (2200 to 0600).

**MEASURES**

All workers completed a modified version of the standard shiftwork index (SSI), a battery of questionnaires specifically designed for assessing problems related to shiftwork. A full description of the measures, their psychometric properties, and the development of the battery have already been described.26 This SSI has previously been used in shiftwork research and has been shown to differentiate between different types of shift systems or features of

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### Table 1

<table>
<thead>
<tr>
<th></th>
<th>12 h (n = 92)</th>
<th>8 h (n = 70)</th>
<th>df</th>
<th>F or χ²</th>
<th>P value</th>
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<tr>
<td>Age (y)</td>
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<td>42±4</td>
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<td>Married (%)</td>
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<td>Years on present shift system</td>
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<td>11±2</td>
<td>1,160</td>
<td>26-99</td>
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<tr>
<td>Hours a week</td>
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<td>44-2</td>
<td>1,153</td>
<td>65-82</td>
<td>***</td>
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</table>

***P < 0.001.

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### Table 2

**Examples of the types of shift rota worked by the two groups over a 28 day period**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 12 h 3/3 | D | D | D | — | — | N | N | N | — | — | D | D | D | — | — | N | N | N | — | — | D | D | D | — | — | N | N | N | — | — | D | D | D |
| 12 h 2/2 | D | D | — | — | N | N | — | — | D | D | — | — | N | N | — | — | D | D | — | — | N | N | — | — | D | D | — | — | N | N | — | — | D | D | — | — |
| 12 h 2/2/4| D | D | N | N | — | — | D | D | N | N | — | — | D | D | N | N | — | — | D | D | N | N | — | — | D | D | N | N | — | — | M | M | A | A | N | N | — | — | M | M | A | A | M | A | A | A | N | N | — | — | M |

12 h 3/3 and 12 h 2/2 = the most common forms of 12 h systems; 12 h 2/2/4 = a less common form of 12 h system; 8 h = an example of an 8 h system; D = day shift; N = night shift; M = morning shift; A = afternoon shift; — = rest day.
Comparison of eight and 12 hour shifts: impact on health, wellbeing and alertness during the shift

Questionnaires were distributed by personnel within each organisation and returned directly by individual respondents to the researchers with prepaid envelopes. Unless stated otherwise, higher scores are associated with experiencing more of the problem being measured. The specific measures used were:

- Biographical information
- Work related information
- Psychological wellbeing (examined with the general health questionnaire)
- Neuroticism (items from the Eysenck personality inventory were used)
- Physical ill health
- Social and domestic disruption
- Attitudes towards shiftwork
- General job (not shift) dissatisfaction (after Hackman and Oldham)
- Sleep duration
- Amount of sleep needed each day, irrespective of shift (this, together with sleep duration, was used to compute the percentage of preferred sleep actually obtained)
- Sleep quality and disturbances
- Chronic fatigue (defined as "a general tiredness or lack of energy irrespective of whether a person has not had enough sleep or has been working hard, and which persists even on rest days and holidays")
- Retrospective alertness rating scale.

The retrospective alertness rating scale was a measure developed by Folkard et al. It was an additional measure which was not included in the original SSI. Respondents were asked to indicate how alert or sleepy they normally felt at two hourly intervals before, during, and after the shifts that they normally worked. In the case of the night shift they were asked to do this for their second and subsequent successive night shifts rather than their first. This was to avoid any potential difference on the first night shift that might result from the typically longer period of earlier wakefulness. Respondents rated how alert they felt at two hourly intervals on a nine point rating scale (1 = very alert; 9 = very sleepy (fighting sleep)). For the analyses the scales were reverse scored so that higher scores were indicative of greater alertness.

Results

Analyses

Given the differences between the two groups in the number of hours worked a week, the number of years spent working on the present shift system, and the potential influence which each of these may have on the outcome measures taken, initial correlational statistics were computed. The only outcome measure with which years on the present shift system was significantly correlated was cardiovascular disease ($r = 0.16, P < 0.05$). For hours worked a week significant associations were found for neuroticism ($r = 0.17, P < 0.05$), sleep disturbances between morning (day) shifts ($r = 0.23, P < 0.01$), and sleep disturbances between night shifts ($r = 0.17, P < 0.05$). Consequently, for these four outcome measures analyses of covariance were used, controlling for the relevant variables. Analysis of variance was used for the remainder of the comparisons, unless stated otherwise. Table 3 shows the results of the analyses, the mean scores adjusted where appropriate, and the results of the analyses comparing the 12 hour group with the eight hour group on the health, wellbeing, sleep, and satisfaction measures.

Psychological wellbeing

There are two ways of scoring the general health questionnaire. The first represents a measure of mental health over the past few weeks and the second estimates the degree of psychiatric morbidity in the population. There was no difference in either reported psychological ill health, or incidence of psychiatric morbidity, between the 12 hour group and the eight hour group.

The eight hour group reported higher neu-

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Table 3: Analyses of measures of health, wellbeing, sleep, and satisfaction

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<thead>
<tr>
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Comparing sleep disturbances between:

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<td>n = 70</td>
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*P < 0.05; **P < 0.01; ***P < 0.001.
roticism than the 12 hour group, although after controlling for the number of hours worked a week the effect did not reach significance.

Physical ill health
There was no difference in the incidence of gastrointestinal complaints between the 12 hour group and the eight hour group. However, the eight hour group did report significantly more symptoms of cardiovascular disease than the 12 hour group, even after controlling for the effects of years of experience of the present shift system.

Social and domestic disruption
The eight hour group reported significantly more disruption to their social life than the 12 hour group. However, they did not report more disruptions to their domestic life or to their non-domestic life—for example, going to the doctor, dentist, or bank.

Attitudes towards shiftwork and general job dissatisfaction
The eight hour group seemed to be more satisfied than the 12 hour group, in that the advantages of their shift system significantly outweighed the disadvantages. However, when asked whether they would prefer to give up working shifts altogether and take up a job without shifts, the 12 hour group reported significantly less desire to do so than the eight hour group. There was, however, no difference between the 12 hour group and the eight hour group in levels of general job dissatisfaction.

Sleep duration and quality
Table 3 shows mean sleep durations between two successive shifts, percentages of sleep obtained, and sleep quality scores for morning (day) shifts, afternoon shifts (for the eight hour group), night shifts, and rest days. Durations of sleep reported by the 12 hour group on the day shift were significantly longer than those reported by the eight hour group on the morning shift, but significantly shorter than those reported by the eight hour group on the afternoon shift. There was no significant difference between the two groups on their respective night shifts, but durations of sleep reported by the 12 hour group on nights were significantly shorter than those reported by the eight hour group on the afternoon shift. There was no significant difference between the two groups on rest days. The reported amounts of sleep needed (irrespective of which shift was worked) by the 12 hour group and the eight hour group did not differ. Therefore, the differences between the two groups, in terms of percentage of preferred sleep obtained, reflected these differences reported for the durations of sleep.

When working on the day shift, the 12 hour group reported better quality and less disturbed sleep than the eight hour group when working on the morning shift, although after controlling for the average number of hours worked a week the analyses did not reach significance. The 12 hour group, when on the day shift, reported significantly poorer quality and more disturbed sleeps than the eight hour group, when working on the afternoon shift, even after controlling for the average number of hours worked a week. There was no difference in sleep quality between the two groups on night shifts. The 12 hour group, when on the night shift, reported significantly poorer quality, and more disturbed sleeps than the eight hour group when working on the afternoon shift, even after controlling for the average number of hours worked a week. There was no difference in sleep quality between the two groups on rest days.

Fatigue and alertness
There was no significant difference in reported chronic fatigue between the 12 hour group and the eight hour group.

A two way (2 × 12) analysis of variance was performed on the alertness ratings, with shift system as the factor between subjects and time of day as the factor within subjects. The analysis incorporated corrections for sphericity with methods already described.19 Later analyses were conducted with the Bonferroni procedure for multiple comparisons. At 0600, 1400, and 2200 there was an overlap in the data of ratings obtained from workers in the eight hour group who were at the end of a shift and those who were beginning a shift. Analysis with ratings obtained from the beginning of each shift are reported in detail here. Separate analysis with ratings from the end of the shift, but not reported here, indicated thatratings from the beginning or end of the shift resulted in the same pattern of effects. There was no significant difference between the mean ratings of alertness on shift between the 12 hour group and the eight hour group (F11,1516 = 1.48, P > 0.05). The factor within subjects, time of day, was significant (F11,1516 = 90.16, P <
Comparison of eight and 12 hour shifts: impact on health, wellbeing and alertness during the shift

0.001), as was the interaction term between shift system and time of day (F11,1518 = 7.99, P < 0.001).

The figure shows the average ratings of alertness on shift for the 12 hour group and the eight hour group. Alertness ratings by both groups declined sharply across the night shifts until 0600. At this time, the 12 hour group, who were nearing the end of their shift, were reporting significantly lower levels of alertness than those in the eight hour group who had just begun a new shift (t128 = 3.73, P < 0.05). Alertness remained at similar levels for the two groups between the hours of 0800 and 1400. Once again the 12 hour group, who were half way through their shift, reported significantly lower alertness than those in the eight hour group who were beginning a new shift (t137 = 3.59, P < 0.05). Reported alertness among the 12 hour group remained significantly lower than that reported by the eight hour group at 1600 (t97 = −2.01, P < 0.05) and 1800 (t220 = 3.46, P < 0.05). At the third changeover point in the eight hour shift cycle (2200), there was no significant difference in reported alertness between the 12 hour and the eight hour workers (t138 = 0.74, P > 0.05).

Discussion

In view of the paucity of studies which have compared the effects on health of eight hour and 12 hour shifts, the results of the present study are particularly interesting. The 12 hour and eight hour shift workers had similar levels of psychological health and gastrointestinal complaints and the 12 hour shift workers had fewer symptoms of cardiovascular disease. In line with the published arguments about the advantages of working fewer yet longer shifts for social and leisure activities—that is, longer periods away from work—the 12 hour shift workers reported significantly less disruption to their social life than did the eight hour shift workers.

Contrary to what might have been expected, higher levels of chronic fatigue were not reported by the 12 hour compared with the eight hour shift workers. Most of the 12 hour shift workers worked only two, or sometimes three, shifts in a row before having either two or three rest days. Thus, working 24 hours in a 48 hour period, and then having at least 48 hours off may provide the necessary time for recovery and thereby help to avoid the build up of fatigue. The fact that only two night shifts in a row were scheduled, and three once every four to five weeks, would perhaps also contribute to reducing levels of fatigue. Such a schedule may help to minimise circadian change, and thereby help to minimise the build up of fatigue which often results from poorer quality day time sleep.21

Another factor which may help in keeping levels of chronic fatigue to a minimum is the later start time of the day shift for the 12 hour shift workers compared with the start time of the morning shift for the eight hour shift workers. The start time of the morning shift is very closely linked to sleep duration before the shift,22 as many shift workers are not able to advance the onset of their sleep to compensate for the sleep lost due to the very early start of the shift. Thus, a start time of 0700 compared with 0600 would potentially allow for longer sleeps. To further support this view, the 12 hour shift workers in the present study actually reported significantly longer sleeps between day shifts, than the eight hour shift workers between their morning shifts.

The effects on sleep of sequencing of shifts and the subsequent build up of fatigue may also account for the trends in alertness. Similar levels of alertness were found in the two groups during the morning. This contrasts with previous research, in which the eight hour shift workers were shown to start the day more alert than the 12 hour shift workers.22 As noted above, the sequencing of shifts in the current study seem to have been organised in such a way as to promote longer sleeps, thus compensating for the effects of the duration of the shift. Similarly, the higher levels of alertness reported by the eight hour group compared with the 12 hour group in the afternoon may be, at least in part, a consequence of the superior quality and duration of sleep achieved when working afternoons, compared with that reported by the 12 hour group when working nights. The difference may also be partly due to differences in the amount of time on shift that had elapsed. However, there was no difference in alertness between the two groups at 2000, although the 12 hour group had only just begun work and the similar hour was nearing the end of their shift. Again, this equivalence in alertness may be due to the superior sleeps reported by the eight hour group when working afternoons, compared with the 12 hour group when working nights.

It would seem plausible to attribute at least some of the differences found in the present study to the effects of the different types of shift systems. It is unlikely that the differential responses were related to differences between the actual workers involved. Most personal factors and work specific variables were constant across the two samples and the samples which showed differences were subsequently controlled for in the analyses. Moreover, despite the fact that all the measures taken were self reported, and as such any results should be interpreted with some caution, it is worth noting that previous studies have shown these measures to be sensitive to differences in shift systems, or features of shift systems, in line with theoretical published arguments.24 Nevertheless, it is acknowledged that, despite careful selection and matching of the eight hour and 12 hour workers, as well as the use of analyses of covariance where appropriate, it is possible that extraneous and confounding differences could have remained between the groups. These should therefore be viewed as preliminary findings that warrant further investigation with larger samples.

In conclusion, compressing the working week into fewer yet longer shifts may not be entirely problematic for the workers concerned. In fact, in the present study advan-
tages in health and wellbeing were evident for the 12 hour shift workers. However, attitudes towards shiftwork were mixed and not entirely favourable. Moreover, the advantages of 12 hour shifts are also counteracted by findings of inferior alertness among the 12 hour workers at certain times of day. This highlights the need for further research into the implications for safety and performance of workers operating on systems of prolonged shifts before they can be recommended on the basis of the advantages identified in the current study. It could be argued that the sequencing and timing of the shifts are more important than the actual duration of shift, and that these ought to be taken into consideration when lengthening shifts beyond the traditional eight hours.

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